Status of shower reconstruction

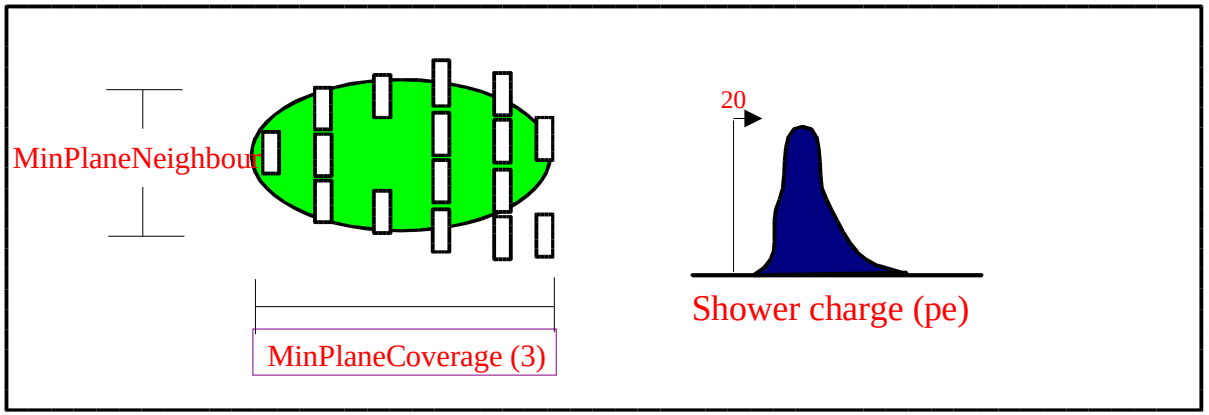
- Efficient reconstruction of the shower is a requirement for NC and ν_e events − in fact differences in shower topology can be used to discriminate between them (see Brett's plot from previous ν_e meeting).
- Currently there are 1.5 shower reconstruction algorithms floating about − Roy's ShowerSR package and Andy Blake's package.
- Current emphasis in reconstruction is on the Tracker for the atmospheric CC ν_μ studies − time to look at the shower reconstruction

SR algorithm − a precis

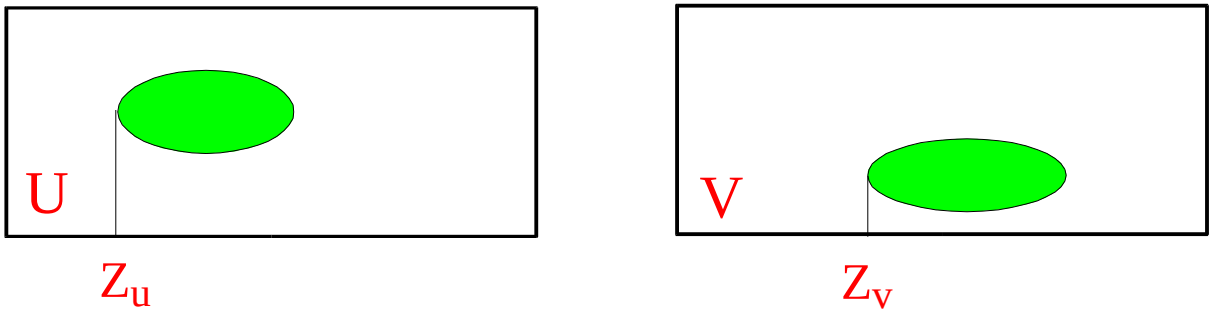
1) Strip association within planes

StripNeighborStripDiff<5
StripNeighborTimeDiff<1 ns

2) Global cluster formation in 2D with topology cuts



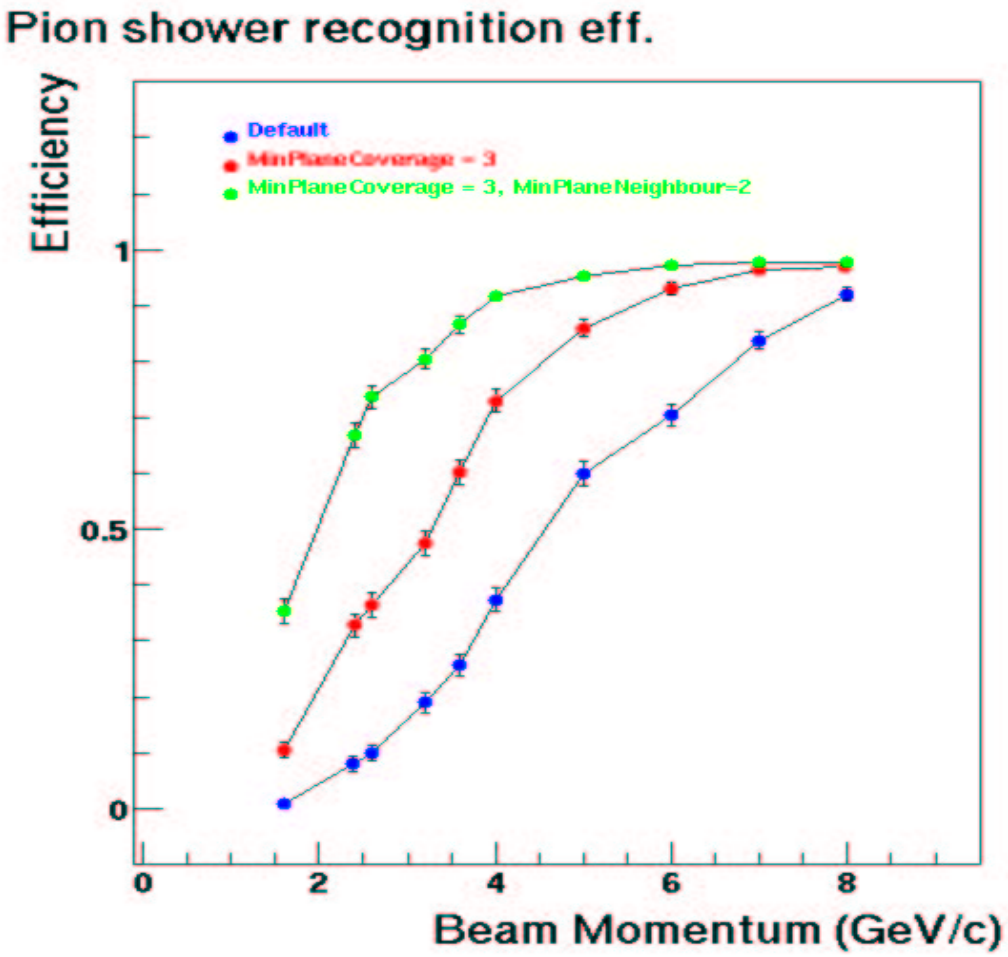
3) Combination of 3D clusters in 3D showers



$|Z_u - Z_v| < 6$ planes, Beginning times < 30 ns

Efficiency using Caldet data

- 2002 CalDet test beam at CERN.
- 10 momentum points.
- Negative polarity data was used to eliminate protons from sample
- Default (at the time) + tuned.
- Incoming pions normally incident (no angle effects)



Some comments

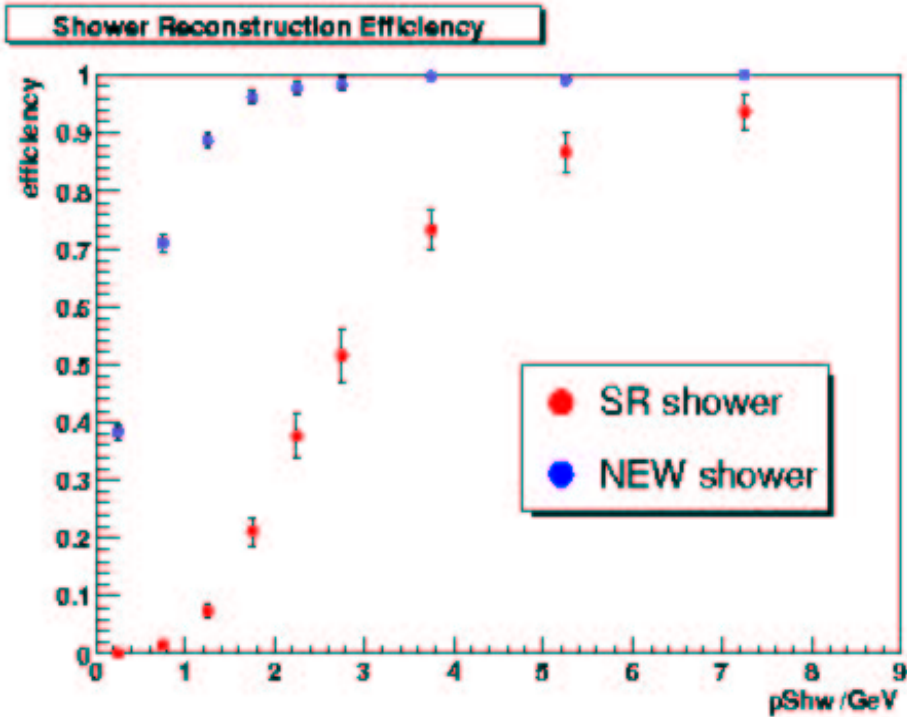
- Main cause of inefficiency is the topology cut on shower length
- Highly dependent on shower angle − at least a cos(θ) effect
- Can this just be removed? How much junk (demultiplexer issues, noise...) will be accepted? Use only clusters of "sufficiently high pulse height"? (I'm trying this now)
- Clustering is done on a global PlaneView basis. Can we achieve something more by clustering at the plane level, looking for track−like and shower−like seeds and then trying to form 2D clusters?
- Pulse height information is not used beyond quality control. Try to seed clustering based on pulse height.
- Tracking and showering algorithms are independent − the Tracker will find tracks in a pure shower. Is it more sensible to have an algorithm which uses track and shower information at the same time, or does several passes to reassign strips and clean up the events?

Cambridge algorithm

- Andy Blakes algorithm seems to address some of these issues (I haven't seen the code yet but have been promised it − I really want to try it out on CalDet topology)
  - No topology criterion
  - Track/Shower reconstruction is simultaneous.
  - Clustering starts at the plane level.
  - ShowerSR hasn't been turned to atmospheric ν.
  - Don't know if the extra showers his algorithm has found are true showers or junk
  - Vertex showers at track ends.
  - Still no real use of pulseheight information
  - Haven't gauged quality of reconstruction yet

- **Shower reconstruction efficiency**

(events that pass trigger) ATM MC (CC,NC)



	νμ CC	νe CC	NC
Interaction	5400	2900	1400
SR Reco			
Track only	3300	700	300
Shower only	0	100	0
Track+Showe	500	500	100
Camb. Reco			
Track only	2100	300	100
Shower only	600	1500	500
Track+Showe	1600	200	300

- Numbers are indicative of algorithm performance but should be taken with a grain of salt at the moment.
- 0 Shower only −> 500 ?
  - SR Reco not tuned
  - SR reconstructs many showers as tracks. Camb "combined" algorithm is less sensitive to this sort of thing.
- Andy tells me that he still has optimisation to do on the shower part of the algorithm
- A lot of good work has been done here but it needs to be understood thoroughly. It will be useful to test it on data.

- Two different approaches to shower reconstruction now. Much of the power of Andy's algorithm is not so much clustering (from what I understand the clustering algorithms aren't all that different − the major differences being that Andy doesn't have topology cuts and clusters from the plane level) as the combination of the track and shower reconstruction algorithms and the resultant information feedback.
- Pulse height is an obvious extra piece of information that is being used sparingly (I'm making a tentative attempt at an SR like algorithm using pulse height as the cluster seed − can't say much about that as I'm still painfully writing it)
- The more the merrier! If anyone has a favourite one then give it a whirl.
- We may end up using multiple algorithms with some sort of figure of merit to distinguish event types of interest.